

Triple oxygen and nitrogen isotopic constrains on the fate of nitrate in East and West Brøgger Glacier near Ny-Ålesund, Svalbard

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Recent studies have demonstrated unexpected levels of microbial activity in High Arctic glacial ecosystems. In ecosystems, biological processes (e.g. nitrification, denitrification, and assimilation) accounts for NO_3^- production and consumption in the internal nitrogen cycle. As a result, tracing the fate of NO_3^- from atmospheric deposition, melting glacier, river waters in glacial system provides valuable information about the interactions between the internal nitrogen cycle and its relationship with nitrogen inputs and outputs.

Nitrogen and oxygen isotope ratios can often be used for tracing source and transformation processes for nitrate. In addition to the traditional isotopic ratio values ($\delta^{15}\text{N}$ and $\delta^{18}\text{O}$), one can now obtain the $\Delta^{17}\text{O}$ value, which is a deviation from the mass-dependent fractionation law ($\delta^{17}\text{O} = 0.52 \delta^{18}\text{O}$), and a unique and powerful tracer of atmospheric photochemistry. In contrast, the NO_3^- produced from biological nitrification has a $\Delta^{17}\text{O}(\text{NO}_3^-)$ value of 0‰, owing to the contribution of two oxygen atoms from H_2O and one oxygen atom from O_2 , (which both follow the mass-dependent fractionation law), during NO_3^- production. Furthermore, isotopic compositions are changed for NO_3^- loss by denitrification/assimilation and follow the mass-dependent fractionation law, that results in a consistency of the $\Delta^{17}\text{O}(\text{NO}_3^-)$ values even after being undergone to physical and chemical processes. Consequently, analyses using $\Delta^{17}\text{O}(\text{NO}_3^-)$ values enable us to quantify atmospheric fractions in ecosystems.

We conducted field sampling in East and West Brøgger Glacier near Ny-Ålesund, Svalbard at July and August, 2018. Total 40 samples are collected from new snow, glacial ice, and river waters, and analysis is now underway. In the presentation, we will show preliminary results of spatial variation of $\Delta^{17}\text{O}(\text{NO}_3^-)$ values and discuss the fate of nitrate deposited and produced in the glacial ecosystem and watershed.